



comp. 2. 9  
(1-28)





Wells who wants  
to go to the  
North Pole, I want  
people to subscribe  
to buy a ship.

Feb 2. 1873—

March 2nd 1881

To the

Trustees of the

University of

Feb 2. 1873.

Hiddry Lodge.  
Kensington.

My dear Sir

I return your papers  
with some mementos in  
the ~~form of~~ ~~as the~~

Memoirs. If I were  
getting up a subscription  
I would avoid attacking  
Theorists and starting  
and say as little about  
Theorists as I can. ~~Theorists~~  
Science is ~~impossible~~  
~~Opinions~~ ~~are~~ ~~all~~  
My ~~own~~

ature at great depth. On July 12th, when in 60 fathoms, the  
vessel was fixed in the ice, the temperature gradually increased to 64° F.  
at a depth of 600 fathoms. These facts indicate the southward flow of  
vast body of warm water. It cannot be said that the heat is derived  
from the Gulf-stream, because nowhere in its course, even in such lati-

no Sir

This indicates that the <sup>salt</sup> equatorial current  
does not make the ice <sup>fast</sup> ~~fast~~ at 33°

been that the best  
chance of getting to  
the North Pole is to  
follow the Equatorial  
<sup>North East</sup>  
Current. I suppose  
~~that~~ ice grows

on the Polar Basin  
in winter  
streams on the edge  
of it, and escapes  
S. the West  
by ~~the~~ openings in



by Greenland & by Asia

it! In so doing

it <sup>probably</sup> leaves an  
open space, <sup>in the middle of summer</sup> a

gap may possibly  
<sup>into open water</sup> work through some  
~~opening~~ <sup>line</sup> in the spreading

ice ~~which~~ is

~~slowly~~ moving out  
of the basin  
away from the

Pole for reasons  
which I showed you

perature at great depth. On July 12th, when in  $80^{\circ} 17' N.$ , and when the vessel was fixed in the ice, the temperature gradually increased to  $64^{\circ} F.$  at a depth of 600 fathoms. These facts indicate the southward flow of vast body of warm water. It cannot be said that the heat is derived from the Gulf-stream, because nowhere in its course, even in such lati-

This indicates that the <sup>salt</sup> equatorial current

NO 5

This day, in a ~~month~~  
~~about~~ between Greenland  
my version. I want, advise  
And I hope to have  
you to revise your manuscript  
before you send it to <sup>the</sup> ~~I~~ ~~have~~  
~~published~~ It needs editing

No coin to spare  
were luck  
And I am too sick

to go myself, but  
I think that you are  
on the right track  
& I wish you <sup>to</sup> ~~luck~~ <sup>success</sup>

I am  
Yours very truly

Observations on the Temperature of the Arctic Sea in the neighbourhood of Spitzbergen. By JOHN C. WELLS, Capt. R.N.

WHILE almost every other nation is making its effort to promote scientific discoveries in the high latitudes of the north, England remains inactive.

My object in addressing the following remarks to the Royal Society is to bring to its notice the voyages of the 'Samson' yacht, and to direct attention to some points on the temperature of the Arctic Sea, to which access is obtained through the broadest gateway to the north, *i. e.* that between Greenland and Norway, the portal of which is guarded by Spitzbergen. In the western portion, along the coast of Greenland, it is more or less blocked with ice, and the water is cold. In the eastern part, in the vicinity of Spitzbergen, there is warm water and an open sea at certain seasons of the year as far north as  $81^{\circ}$ , and in some years one or two degrees further. Nearly all the discoveries in these regions have been made by persons engaged in commercial enterprise; so that, even when favourable opportunities offered, their interests restrained them from taking advantage of the same.

In 1871 Mr. B. Leigh Smith made a cruise in his schooner yacht 'Samson,' and reached  $81^{\circ} 24' N.$ , with an open sea before him, comparatively free from ice. The pack-ice was drifting southwards, and the water at the surface was  $33^{\circ} F.$ , while at 300 fathoms it was  $42^{\circ} F.$  This fact was observed by Capt. Scoresby in lat.  $78^{\circ} N.$ ,  $0^{\circ} 10' W.$ , surface  $32^{\circ} F.$ , and at a depth of 760 fathoms  $38^{\circ} F.$  In 1872 a second cruise was undertaken, in which I had the pleasure of accompanying Mr. Smith. On this occasion the sea was crowded with ice, and the ship was beset. The ice had evidently required more than one year for its formation; its surface was covered with opaque snow, and was generally flat, and in no case rose higher than the gangway of the little schooner.

Owing to the floes presenting a comparatively smooth surface, with a total absence of icebergs, we were led to form the opinion that no land can exist in the vicinity immediately north of Spitzbergen, as the southerly drift would be sure to bring down floating bergs, which are always formed in the valleys of northern land.

On this occasion observation with the Miller-Casella thermometer confirmed the result of the previous year, *viz.* gradual increase of temperature at great depth. On July 12th, when in  $80^{\circ} 17' N.$ , and when the vessel was fixed in the ice, the temperature gradually increased to  $64^{\circ} F.$  at a depth of 600 fathoms. These facts indicate the southward flow of vast body of warm water. It cannot be said that the heat is derived from the Gulf-stream, because nowhere in its course, even in such lati-

*no sur*  
This indicates that the <sup>Gulf</sup> equatorial current  
dived under the ice & water at  $33^{\circ}$   
its least density.

The  
whole  
Carpenter  
current.

tudes as  $50^{\circ}$  or  $60^{\circ}$ , does it acquire so high a temperature, even at the surface; and it is highly improbable that the general warmth of the ocean along the west coasts of North Europe, on the shores of Norway, could possibly be supplied by the limited body of warm water which leaves the Gulf of Florida. If the whole of the Gulf-stream water were spread over the warm-water area in the north, its depth, even allowing the most liberal estimate for its volume, would not exceed 10 fathoms; whereas warm water of  $42^{\circ}$  F. occurs to the depth of 400 fathoms in this region, and north of Spitzbergen it is found as high as  $64^{\circ}$  F. at 600 fathoms. If it be said that this temperature is due to the northward drifting of the Atlantic from warmer localities, we are met by two difficulties, of which one is, that the soundings obtained by Carpenter and others gave temperatures much below  $64^{\circ}$ , and the other is, that the waters flow south, not north. Volcanic action, or a warm mineral spring rising from the ocean-bottom, may by some be imagined to be the cause of the temperature of  $64^{\circ}$ ; but there is no evidence of either of these agencies, and it is quite reasonable to suppose any other feasible cause. Passing over the discovery of  $64^{\circ}$  F. at this depth, we still have to account for the water of  $42^{\circ}$  F. flowing southwards, as evidenced by the increase of its temperature as we proceeded northwards.

That  
30

It is clear that this question of temperature requires further investigation; and it is also clear that whatever the result may be, it will materially affect all the prevailing theories respecting oceanic currents. It is not improbable that this warm water flows from the circumpolar region; and if so, it would indicate a circumpolar sea.

10.  
that  
is fine

Many facts are known which are consistent with this view. Every year the edge of the pack-ice, and the ice-fields themselves, break up and drift south, at a rate sometimes equal to thirteen miles a day, as found by Capt. Parry. This does not occur when the northern ocean is wholly covered with ice, in the winter season. The drifting of the ice (as also currents) implies a sea free of ice somewhere in the north, occupying an area at least as extensive as the drift-ice. As has been seen, some of the ice is the result of more than one year's growth: and as the ice travels southerly, say, from four to thirteen miles or more per diem, a similar area of open sea must be simultaneously forming round the pole, the ice-holes and clear spaces in the drift-ice being quite insufficient to make up for the space left by the ice during the summer. The great abundance of animal life in the waters of the highest latitudes reached indicates that the water is not ice-cold; and the migration of numerous species to the north of  $80^{\circ}$  shows that the means of subsistence can be obtained. There is reason to believe that whales occur far to the north of  $80^{\circ}$ ; and if so, there must necessarily be sufficient open water to allow of their finding ready access to air.

In the Spitzbergen seas a blue, cloud-like appearance is well known as a sign of open water; and this has been seen on the distant north horizon

on Sunday Feb. 2, 1873. The author did not know that water at  $40^{\circ}$  is heavier than water at  $33^{\circ}$ .

even by ships which have been beset by ice in the highest latitudes. Icebergs, it is well known, waste more rapidly below the surface than in the air, causing them to topple over frequently, obviously the effect of the warm current.

The question, then, is, from whence do the warm waters come? and how do they acquire their heat? And this is one of the questions which a polar voyage by way of Spitzbergen would almost certainly elucidate. Another important subject of investigation would be the conditions under which the prevalent north winds of high latitudes originate. There is one argument bearing upon the temperature of the circumpolar seas which should not be overlooked. During six months of the year the sun is above the horizon; and although the rays may be oblique, still the waters may acquire a higher temperature than under similar conditions further south, owing to there being little or no cooling from nocturnal radiation, and probably to the constant dryness of the air allowing the sun to strike with full power. During the winter these causes would intensify the cold.

The occurrence of warm water is by no means confined to the sea around Spitzbergen; but, before referring to other regions, we may mention that a set of instruments for taking soundings and deep-sea temperatures was supplied this year by Mr. Smith to Capt. David Grey, of the whaler 'Eclipse,' whose father, in the year 1855, supplied the valuable information and survey of the extension of Pond's Bay, now called Eclipse Sound. His observations were made in the middle of the sea, between Greenland and Norway, and along a line running north-easterly from Iceland. They coincide with Dr. Carpenter's observations, proving the termination of the Gulf-stream. In June 1854 Morton advanced beyond Kennedy Channel, and saw open water as far as the horizon, visible from a hill 500 feet high. The wind was from the north-west, and a rain-cloud was seen in the distance above the open sea. The water was setting in a strong current south, and the ice along the shores was in a rapid state of dissolution. The water was found in the several places tried to be well above the freezing-point; and in one place, some distance from the ice-foot, and at a depth of 5 feet, the temperature was 40° F. There was a strong tide from the north. Kane's vessel wintered in Renselaer Harbour; the strait was bridged across by ice, with a current running south flowing beneath it. Although the open waters above alluded to may not be direct evidence of a comparatively mild circumpolar region, yet the stream of warm water coming from the north seems to indicate it.

Where can this water acquire its warmth? Sir John Richardson suggests that it is derived from the warm area near Spitzbergen; but this is not supported by evidence, which indicates that in both areas the water comes from the north. It has been suggested that it is a continuation of the Gulf-stream, apparently because it is supposed to supply all the warm water in the Arctic seas; but if there is no reason for believing that the warm sea around Spitzbergen derives its heat from this source, it is still

*Ice & the light surface water is but the  
heavier & warmer water below is going north  
show the another way to go.*

*Iceland  
that it  
is coming  
from  
the  
north  
The*

less credible in the case of the Kennedy-Strait water. It has been suggested that the source of warmth is the northward flow of the general mass of the North Atlantic. If this did account for the warmth of the Spitzbergen area, although this view would be with difficulty reconciled with a southward flow of Arctic water, it would be quite inapplicable to the Kennedy-Channel area.

Temperatures taken by Mr. B. Leigh Smith and Capt. Wells, R.N.

| 1872. | Station. | Lat.       | Long.     | Depths<br>in<br>fathoms. | Temperature. |               |      |      |
|-------|----------|------------|-----------|--------------------------|--------------|---------------|------|------|
|       |          |            |           |                          | Air.         | Sur-<br>face. | Min. | Max. |
| June  |          |            |           |                          |              |               |      |      |
| 1.    | 1.       | 68° 52' N. | 6° 40' W. | 600                      | 42           | 37½           | 30   | 37½  |
| 13.   | 2.       | 75° 6' N.  | 2° 30' W. | 100                      | 36           | 31            | 28   | 35   |
| 15.   | 3.       | 75° 7' N.  | 3° 48' W. | 100                      | 36           | 32            | 28   | 35   |
|       |          |            |           | 50                       | ...          | 31            | 29½  | 32½  |
| 17.   | 4.       | 76° 13' N. | 2° 22' W. | 100                      | 34           | 31            | 29½  | 34   |
| 18.   | 5.       | 76° 3' N.  | 0° 10' E. | 150                      | 35           | 33            | 30½  | 40   |
|       |          |            |           | 200                      | ...          | 33            | 30½  | 48   |
| 19.   | 6.       | 76° 21' N. | 1° 5' E.  | 150                      | 35           | 32            | 30½  | 32   |
|       |          |            |           | 250                      | ...          | 32            | 30½  | 39½  |
| 20.   | 7.       | 76° 35' N. | 0° 3' W.  | 6                        | 34           | 33            | 30   | 33   |
|       |          |            |           | 25                       | ...          | 33            | 30   | 35   |
|       |          |            |           | 150                      | ...          | 33            | 30   | 39½  |
| 22.   | 8.       | 76° 41' N. | 2° 10' W. | 150                      | 35           | 32            | 29½  | 39½  |
| 27.   | 9.       | 77° 18' N. | 5° 0' E.  | 25                       | 37           | 34½           | 32   | 34½  |
|       |          |            |           | 250                      | ...          | 34½           | 32   | 39   |
| July  |          |            |           |                          |              |               |      |      |
| 1.    | 10.      | 78° 20' N. | 7° 2' E.  | 6                        | 36           | 36            | 33   | 36   |
|       |          |            |           | 600                      | ...          | 36            | 33½  | 36½  |
| 6.    | 11.      | 79° 54' N. | 6° 34' E. | 6                        | 35           | 34½           | 33   | 34½  |
|       |          |            |           | 12                       | ...          | 34½           | 33   | 35   |
|       |          |            |           | 25                       | ...          | 34½           | 33   | 37   |
|       |          |            |           | 50                       | ...          | 34½           | 33   | 37   |
|       |          |            |           | 200                      | ...          | 34½           | 33   | 40   |
|       |          |            |           | Bottom                   |              |               |      |      |
| 7.    | 12.      | 80° 4' N.  | 5° 12' E. | 600                      | 37           | 34½           | 31½  | 39   |
| 10.   | 13.      | 80° 23' N. | 9° 0' E.  | 12                       | 35           | 31            | 28   | 31   |
|       |          |            |           | 50                       | ...          | 31            | 28   | 31½  |
|       |          |            |           | Bottom                   |              |               |      |      |
| 12.   | 14.      | 80° 32' N. | 9° 50' E. | 600                      | 36           | 31            | 28½  | 64   |

This proves that which necessarily  
occurs from the density of

Among the many advantages that would result from circumpolar research and the following up of this warm current, not the least important would be the insight which it would probably afford as to the regulating influences of the weather of North Europe, or generally of the northern hemisphere. Meteorologists have long suspected that the weather in Western Europe depends in some way upon what has happened in the vicinity of the pole. The many advantages to be gained to science by circumpolar navigation cannot be doubted. Among them would be careful observations of the currents and temperatures of the surface and at various depths, and organisms which doubtless would be obtained by dredging, as far as practicable, in the bed of the Arctic Sea, in the highest latitude, and the probable extension of the whale-fisheries, as well as the discovery of new land, should such exist.

June 1.—The edge of the ice was 170 miles distant, and the warm water was found at the surface, and cold water, which is of greater density, below.

June 13.—The sounding was taken at the edge of the pack. If the experiments had been continued, increasing temperature would probably have been found at a lower depth, as was the case further north.

June 15.—To-day we were well in the ice, and had only time to sound in 50 fathoms; but even here we found an increasing temperature.

{ 32  
40

June 17.—Being far in the ice, we only found a slight increase.

June 18.—A second sounding, 50 fathoms deeper than yesterday, when sailing among large pieces of floe-ice, gave an increasing temperature up to 48° F.

June 19.—To-day we had an increase of 7° above the surface-temperature at 250 fathoms deep, although but 10 miles distant from yesterday's soundings; but the ice was more open: probably evaporation occurred here, owing to the surface not being so closely covered with ice.

June 20.—The first sounding shows the water to be coldest at the ice-foot; the second and third prove the increasing temperature, which, as we were somewhat more closely packed in the ice, increased more quickly, and 39° F. is obtained at 150 fathoms deep.

{ 33°  
39

June 22.—Here we were more closely packed. The surface was a degree colder than yesterday, and the water at the ice-foot had also gone down half a degree; but the warm stream below was the same. If we had had time to sound at greater depths, the temperature of the water would in all probability have been found still on the increase.

June 27.—In this case we have the warm current clearly defined at 250 fathoms depth, being kept below by the lighter ice-water, which is nearly fresh and of less specific gravity.

{ 34 1/2  
?

July 1.—We were clear of the ice, and had a lower temperature than before obtained. If the flow of warm water came from the south, the surface-temperature would have been greater than any temperature as yet obtained, because of the absence of ice.

This is all Bosh — J. P.

July 6.—This observation shows a gradual increase as far down as 200 fathoms. We were well in the ice, and were prevented from continuing our sounding-operations. Little evaporation has taken place, owing to the closeness of the ice and the gradual increase of the temperature, with one exception, which occurred on the 18th of June, when a temperature of  $48^{\circ}$  was obtained,—showing that the temperatures are materially affected by local causes, the closeness of the pack or the opening of the ice allowing evaporation to take place.

July 7.—Here, where the ice is close, there is a great difference between the surface temperature and that at the ice-foot. We pulled up a very beautiful description of starfish, which would not be likely to inhabit this warm current were it of volcanic origin.

July 10.—The crew being required elsewhere, we could not continue our sounding-experiments. The sounding shows a decrease of temperature, owing to the ice-water.

July 12.—This remarkable sounding was carefully registered specially by Mr. Smith, who saw the index before it was immersed and immediately on its coming up. This shows a gradual increase of temperature towards the north, proving the current to come from the north; and its temperature being above that of the Gulf-stream, where it disperses itself, is a proof it is in no way connected with it.

The thermometer has since been examined by Mr. L. P. Casella, who certifies that it "has been tested in the hydraulic press, as well as carefully compared with my standard, and found correct in every way, no change whatever having taken place in the instrument."

31°

64°.

32. Fresh water freezes

26 { Salt water freezes  
exhibits the salt &  
blunts as ice.

37 Greatest density  
of water: Fresh

But Concentrated  
Brine would sink  
below fresh water  
at  $37^{\circ}$ . Though it  
64° was at the observed  
temperature.



Temperatures taken by Capt. David Grey, of the 'Eclipse' Whaler.

| 1872. | Station. | Lat.       | Long.      | Depths<br>in<br>fathoms. | Temperature. |               |      |      |
|-------|----------|------------|------------|--------------------------|--------------|---------------|------|------|
|       |          |            |            |                          | Air.         | Sur-<br>face. | Min. | Max. |
| April |          |            |            |                          |              |               |      |      |
| 13.   | 15.      | 68° 45' N. | 13° 58' W. | 220                      |              | 29°           | 28·8 | 32°  |
| 15.   | 16.      | 68 52 N.   | 15 40 W.   | 220                      |              | 29            | 29   | 31·5 |
| 20.   | 17.      | 68 12 N.   | 16 40 W.   | 270                      |              | 28·8          | 28   | 31   |
| May   |          |            |            | Bottom                   |              |               |      |      |
| 14.   | 18.      | 75 0 N.    | 16 20 E.   | 85                       |              | 29            | 29   | 32   |
| June  |          |            |            |                          |              |               |      |      |
| 6.    | 19.      | 78 20 N.   | 0 20 E.    | 400                      |              | 30            | 30   | 33   |
| 8.    | 20.      | 78 14 N.   | 0 18 W.    | 220                      |              | 30            | 29   | 30   |
|       |          |            |            | 400                      |              | 30            | 30   | 32   |
| 18.   | 21.      | 75 5 N.    | 6 15 W.    | 400                      |              | 32            | 29·5 | 32   |
|       |          |            |            | 200                      |              | 32            | 30   | 32   |
| 23.   | 22.      | 74 50 N.   | 6 50 W.    | 100                      |              | 32            | 30   | 32   |
|       |          |            |            | 400                      |              | 31            | 30   | 32   |
| July  |          |            |            |                          |              |               |      |      |
| 3.    | 23.      |            |            | 200                      |              | 34            | 30·5 | 34   |

April 13, 15, 20.—When these three soundings were taken the ship was frozen in the pack; still there is a slight increase of temperature at the lowest depth.

May 14.—Off Bear Island.

June 6, 8.—Here 'Eclipse' was 75 miles inside the pack.

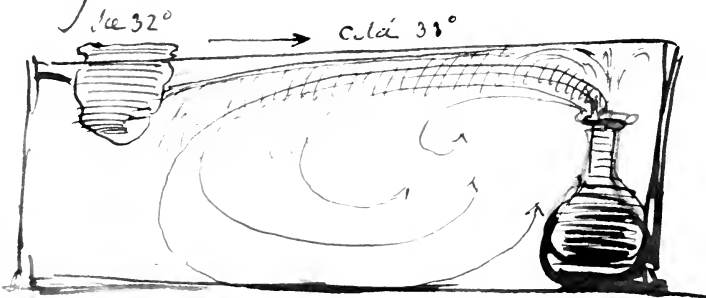
June 18, 23, July 3.—Made fast to a large floe, about 90 miles inside the pack.

*I see nothing in this paper  
to alter any single idea  
that ever entered my head  
on this subject much to  
prove that science is  
science*

and funny funny.

In my tank this morning  
Wednesday 5<sup>th</sup> There  
is a layer of clear cold  
water above the black  
mud. And so there  
was while I was showing

my experiment to



Wells & Ramsay. —

Feb 5. 1873.

J. H. Campbell

July 3<sup>rd</sup> 1873  
Southborough  
Bickney  
Kent.

Dear Mr. Campbell

I am very much obliged  
to you for the remarks &c.

you have made on my paper.

I shall follow your advice,  
and make up the pamphlet.

with the Whaling Captains

evidence <sup>only</sup> and bind it up

with the probable discoveries  
that might be made



men who I hope will  
respond to it.

I should very much  
like to get you to act  
as a committee man,  
because you could then  
inform the Duke every  
thing that was going  
on. There shall not  
be much for you.

A no. I am ~~excused~~

W. Jackson, to get such  
✓  
✓ as yourself who are  
✓ well known.

Yours very truly,  
M.

Wm. Jackson

I did not expect the  
to be to subscribe and  
wish I could manage  
to do that for him.  
I shall retain his name

Wm. Jackson

Feb 5. 1873.

J. H. Campbell









